MOUNTAINS, RIVERS & WATERFALLS: NATURE'S EFFECT ON COMMUNICATING NEGATIVE EMOTIONS

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Florencia Durón Delfín

Thesis Committee

Hye-Ryeon Lee
Kelly Aune
Jessica Gasiorek

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To my brother

Acknowledgments

Thank you...

To the land of Polynesia, particularly Hawai‘i and Tahiti, for a great deal of inspiration.
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Abstract

Communicating emotions is essential to maintain relationships and to strengthen social bonds. Using an experiment, this study examined if the exposure to scenes of nature increases one's level of positive emotions, decreases the level of negative emotions, and affects one's degree of emotion sharing. Women watched either a video of dense vegetation and water (i.e., exposure to nature) or a video of traffic, and the interior of shopping malls and train stations (i.e., exposure to city). Immediately after watching the video, all participants reported how they felt and were asked to write about a painful experience that happened to them recently and their feelings about it. Results show that those who were exposed to nature reported feeling significantly happier, less angry and less fearful compared to those who were exposed to the city. Furthermore, women exposed to nature showed a significant tendency to be more expressive than the women exposed to the city. Those exposed to nature wrote significantly more consequences associated with the event and expressed more pain compared to those who were exposed to the city. Lastly, the odds of suppressing words of anger were 3.8 greater when subjects were exposed to the city than when they were exposed to nature. These results support the hypothesis that exposure to nature promotes emotion sharing by affecting mood. The implications of these findings are discussed.

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Introduction

Communicating one's emotions may be a natural and instinctive human impulse. No matter their age, gender, or culture, people seem to share how they feel with the people they trust the most (Rimé, 2007). Communicating — rather than suppressing — negative emotions promotes physical and mental health. Furthermore, it strengthens the relationship with the listener (Berndt, 2002; Buhrmester & Furman, 1987; Butler et al., 2003; Gross, 1998; Rimé, 2007). It is quite common, however, for people to suppress their emotions during social interactions (Gross, 1998). Research shows that suppressing emotions increases an individual's blood pressure, can potentially lead to negative mental states (e.g., depression), and decreases the relational partner's desire to further communicate with the suppressor (Butler et al., 2003; see Gross & Levenson, 1997). If all relational partners feel less inclined to further communicate with an individual who does not express her feelings, it can potentially isolate the individual (Butler et al., 2003; Gross & Levenson, 1997). Expressing feelings may require the speaker to be in a particular mental and physiological state — a state that promotes sharing. For example, research shows that people communicate more emotions when they produce oxytocin, a neuropeptide that has a calming effect in the body and increases trust in humans (Kosfeld, Heinrichs, Zak, Fischbacher & Fehr, 2005; Lane, Luminet, Rimé, Gross, Timary & Mikolajczak, 2013). It has been observed that natural environments affect people's mental and physiological state considerably (Kuo & Sullivan, 2001a; Miyazaki n.d.; Ulrich, 1981; Ulrich et al., 1991).

Research shows that nature causes a state of relaxation and contentment (Hietanen, Klemettilä, Kettunen & Korpela, 2007; Korpela, Klemettilä, & Hietanen, 2002; Miyazaki, n.d.; Ulrich, 1981; Ulrich et al., 1991; White et al., 2010; see Williams, 2017). Using an experimental method, this study examined if the effects of exposure to nature on an individual's mood affects her disclosure of negative emotions.

Communicating Emotions

Emotions are powerful biological reactions that organize our responses to challenges and opportunities encountered in the environment (Levenson, 1994). In other words, emotions are powerful impulses to act (Goleman, 2006). When we feel anger, for example, blood flows to the hands making it easier to grasp a weapon or strike a punch; the heart rate increases and hormones such as adrenaline are released, generating an impulse for vigorous action (Goleman, 2006). Sadness brings a drop of energy and enthusiasm for life's activities, which facilitates introspection (Goleman, 2006). Emotions are powerful enough to interrupt activities and can temporarily impede cognitive abilities such as remembering and learning (Goleman, 2006; Gross & Thompson, 2007; Watts, 2007).

Communicating an emotion is defined as "sharing a description, in a socially shared language, of an emotional episode to some addressee by the person who experienced it" (Rimé, 2007, p. 467). This description includes the circumstances, thoughts and feelings associated with an event (from now, *communicating an emotion*) (Rimé, 2007). The Theory of Social Sharing poses that an individual *will* seek out someone to share her emotions after a strong emotional event happens (Rimé, 1995). Approximately 90% of people communicate emotions, and 60% do so immediately after the emotional event (Pennebaker, Zech & Rimé, 2001). As the intensity of the emotion felt during the event increases, the more times the story is told, and the longer it is discussed (Rimé, 2007). The emotion is shared with the people the speaker trusts (Rimé, 2007). These "confidants" often consist of family members, friends and romantic partner (Herbette & Rimé, 2004). However, when a person is experiencing something very particular, she may decide to first speak to a stranger who is experiencing the same phenomenon. For example, patients

with chronic disease first seek other chronic disease patients to talk about their emotions rather than their circle of confidants (Herbette & Rimé, 2004). Sharing emotions has been observed across cultures (i.e., Asia, North America and Europe), gender (men and women), and it seems to not be affected by one's level of education (see Rimé, 2007). Thus, communicating emotions may be a universal impulse.

Reasons for Communicating Positive Emotions

Humans share positive emotions for different reasons. Describing an emotion through writing (Pennebaker, Colder & Sharp, 1990) and speech (Rimé, 2007) reactivates the emotion. Thus, people may communicate a positive emotion to get into a good mood (Rimé, 2007). Three different studies showed that communicating a positive event was associated with the enhancement of positive feelings "far beyond the benefits" due to the event itself (see Rimé, 2007, p. 468).

People may also share positive emotions to maintain relationships. Within romantic couples, it has been found that when the speaker communicates a positive emotion and perceives the listener's reaction to be active-constructive (i.e., "my partner usually reacts to my good fortune enthusiastically", "I sometimes get the sense that my partner is more happy and excited than I am", "my partner asks a lot of questions and shows genuine concern about the good event"), the speaker feels more satisfied with the relationship, trusts her partner more, and feels closer to her partner (Gable, Reis, Impett, Asher, 2004).

On the other hand, when the speaker (either man or woman) perceived the partner's reaction as passive-constructive (e.g., "my partner is usually silently supportive of the good things that occur to me") or passive-destructive (e.g., "my partner often seems disinterested") the speakers felt less trust and intimacy towards the partner, and less satisfaction with the relationship (Gable et al., 2004).

Reasons for Communicating Negative Emotions

The reasons for communicating negative emotions are different (Delfosse, Nils, Lasserre, Rimé, 2004; Rimé, 2007). When 106 Belgian teenagers were asked why they communicate negative emotions, the 4 major reasons were: to receive advice (i.e., see other's reactions, see things from a different perspective), to release the emotion (e.g., reduce the intensity of the emotion, find peace), to better understand the situation (e.g., make sense of what happened), and to bond with others (e.g., being heard, being understood, being reassured, to not be alone, to not feel abandoned) (Delfosse et al., 2004). The authors explained that after experiencing a negative emotion, people feel lonely; they feel excluded from the normal lifestyle led by others who didn't go through the same experience (Delfosse et al., 2004). The speaker communicates the negative episode because she wishes to feel accepted, and to feel a sense of belonging once again to a group (Delfosse et al., 2004).

Benefits of Communicating Negative Emotions

Communicating negative emotions brings a number of benefits.

Stress release. Communicating a negative emotion is relieving, which is why people perceive it as beneficial for their well-being (Kahn & Hessling, 2001; Rimé, 2007). Communicating negative emotions helps one recover from distress (see Kahn & Garrison, 2009)

because individuals can better understand the emotion by verbally narrating the thoughts, circumstances and feelings associated with an event (Rimé, 2007) and thus change their perception of the experience into a positive manner (Wagner et al., 2014). Rimé (2007) explains that communicating an emotion is not enough to completely release the emotion, but the perceived relief of doing so is strong enough to decrease stress levels (Pennebaker, Colder, & Sharp, 1990). The perceived decrease of stress experienced while communicating a negative emotion may be powerful enough to strengthen one's immune system. Pennebaker et al. (1990) found that those who wrote every day for 20 minutes the emotions associated with a painful experience, over the course of 12 days, had fewer physician visits for illness by the end of the school year than those who wrote about random topics for the same length of time.

Satisfying socioaffective needs. Perhaps the biggest benefit of communicating negative emotions is satisfying socioaffective needs. Socioaffective needs are the individual's need for love, care, comforting, social support, reassurance, social validation, social integration, and understanding (Rimé, 2007). Since people feel isolated after experiencing a negative event, they need validation, social integration, and reassurance (Delfosse et al., 2004; Rimé, 2007). Simply listening to phrases such as "I know exactly how you felt," "I understand why that affected you a lot," and "I get why you responded like that" activates reward circuits in the brain (Morelli, Torre, Eisenberger, 2013). If the intensity of the speaker's emotion is high, the listener changes her response from verbal to nonverbal cues, such as touching, hugging or kissing (Christophe & Rimé, 1997). Both verbal and nonverbal indications of support help fulfill the speaker's socioaffective needs — particularly in times of vulnerability.

Friendship and bonding. Communicating emotions and responsiveness appear in the literature as the two main requisites to form a friendship (Butler et al., 2003; Reis & Shaver, 1988). Communicating (positive and negative) emotions is absolutely necessary for, not just forming, but maintaining relationships (Butler et al., 2003). Communicating emotions fosters trust (O'Keefe, 2016). Feeling understood also fosters trust (Morelli et al., 2014). An increased mutual sharing of emotions (that may arise from trust) strongly predicts intimacy and quality of friendships (Berndt, 2002; Buhrmester & Furman, 1987).

Communicating emotions is so crucial for bonding that the brain may increase attention to stories in which the protagonist has experienced a strong emotion (Barraza & Zak, 2009; Christophe & Rimé, 1997). Researchers found that the brain produces cortisol (a hormone associated with attention) and oxytocin (a neuropeptide associated with empathy) when listening to an emotional experience (Barraza & Zak, 2009). These two chemicals may serve as helping mechanisms to increase the listener's chances of providing an answer that will satisfy the speaker's sociaffective needs. Thus, disclosing negative emotions strengths important social bonds "within minutes" (Rimé, 2007, p. 478).

Communicating negative emotions also promotes intragroup communication (Rimé, 2007). The emotion of a peer gets easily propagated between the members of a community (Rimé, 2007; Christophe & Rimé, 1997). This way, the members can keep track of the emotions affecting their peers (Rimé, 2007). By helping a peer overcome an emotional issue, the community may remain strong.

Suppression, Thoughts and Negative Emotions

As discussed in the previous section, there are many benefits for communicating negative emotions. However, people often shy away from sharing (Gross, 1998). Why people suppress emotions has to do with their mental and physiological state. Experiencing an intense negative emotion discourages people from communicating the emotion (Campbell-Sills, Barlow, Brown & Hofmann, 2006; Kahn & Garrison, 2009). A study showed that those who reported feeling higher levels of negative emotion while watching a movie also reported higher levels of suppression (i.e., "I try to hold back or suppress my feelings") compared to those who reported lower levels of negative emotion (Campbell-Sills et al., 2006). Research also shows that suppressing the experience of a negative emotion is associated with suppressing the expression of the negative emotion (Butler et al., 2003).

One could argue that the intensity of an emotion is linked to one's thoughts (Gross & Thompson, 2007; Goleman, 2006; Watts, 2007). How a situation is interpreted, or the perceived meaning of a situation, gives rise to an emotion (Gross & Thompson 2007). For example, judging an emotion as unacceptable may increase the intensity of the emotion, and thus chances of suppressing it (Campbell-Sills et al., 2006). One may also fear the idea of showing vulnerability when communicating an emotion, and thus prefers to suppress experiencing the emotion as a strategy to manage it (Kahn & Garrison, 2009). Contemporary research highlights the idea that one may regulate emotions through the regulation of thoughts (Watts, 2007). The intensity of an emotion is probably not determined by a single thought, but by the frequency and the content of the thoughts that proceed the emotion.

There are reasons to believe that natural environments affect the content of one's thoughts. Paying attention to plants, landscapes, sounds, and other products of the Earth (from now on, *exposure to nature*) affects mental activity positively, to the extent that it increases the intensity of positive emotions and decreases the intensity of negative emotions (Hietanen, Klemettilä, Kettunen & Korpela, 2007; Korpela, Klemettilä, & Hietanen, 2002; Park et al., 2010; Ulrich, 1991; White et al., 2010)

Nature may thus alter the experience of the emotion. The new emotion experience may be perceived as more acceptable to express. Furthermore, the new emotion experience may make one more likely to interpret a painful situation with equanimity, perhaps even optimism. If so, the person might be less inhibited and more open to expressing circumstances, thoughts, and feelings related to a painful event.

Nature

Nature and Negative Emotions

The previous section explained that suppressing the expression of a negative emotion is associated with suppressing the experience of a negative emotion, and how the latter is influenced by one's mood and thoughts. Repetitive thoughts focused on negative aspects of the self are called rumination (see Bratman, Hamilton, Hahn, Daily & Gross, 2015). Rumination is associated with depression, and it's negatively correlated with self-compassion (Bratman et al. 2015; Neff, 2003). However, research shows that rumination decreases when one is exposed to nature (Bratman et al., 2015). Nineteen individuals took a 90-minute walk in a green space comprising grassland and scattered trees. Another 19 individuals took a 90-minute walk on a street that had 3 to 4 lanes with steady traffic. All participants completed a rumination scale before and after the walk, and had an fMRI scanning their brains during the walk. Researchers found that self-reported rumination significantly decreased after the walk in the green space. Furthermore, the neural activity in the subgenual prefrontal cortex (sgPFC) decreased among those who walked in the green space. The walk in the busy road had no effects on self-reported rumination or activity in the sgPFC. The sgPFC is an area of the brain related to the processing of sadness, guilt, remorse, negative narratives and peer rejection. Activity in the sgPFC is also associated with behavioral withdrawal (see Bratman et al., 2015). More research shows that negative emotions also decrease while in nature (Park et al., 2010; Ulrich, 1991). Self-report scores of anger and depression were lower across people who observed either a live forest or scenes of nature on a monitor, compared to those who observed the city. These self-report scores matched participant's physiological measures, who experienced lower blood pressure and an

activation of the parasympathetic nervous system when exposed to nature. The reason why negative emotions decrease in nature, authors explain, may be due to the decrease of rumination (Bratman et al., 2015). By decreasing negative thoughts, exposure to nature may decrease the intensity of negative emotion. Because the experience is less intense, the chances of suppressing that emotion may also decrease. If one is less likely to suppress an emotion, she is more likely to communicate that emotion (Butler et al., 2003).

Nature and Positive Emotions

As exposure to nature affects negative emotions, it also affects positive emotions significantly. When people are exposed to nature, they experience joy (Hietanen, Klemettilä, Kettunen & Korpela, 2007; Korpela, Klemettilä, & Hietanen, 2002; Park et al., 2010; Ulrich et al., 1991; White et al., 2010).

In a lab experiment, participants saw 120 pictures and assessed how they felt (1 being very sad and 10 being very happy) while watching each picture. All participants saw 3 sets of pictures. The first set had pictures of buildings, buildings with some greenery, green landscapes with some buildings, and only green landscapes. The second set had pictures of buildings, buildings with some water around them, aquatic landscapes with some buildings, and aquatic landscapes only. The third set had pictures of green landscapes, green landscapes with some water, aquatic landscapes with some greenery, and aquatic landscapes only. In set 1, participants reported feeling more joy as the amount of greenery increased (White et al., 2010). An identical tendency was found for set 2 – as the amount of water increased and the number of buildings decreased, people reported feeling happier. Participants reported feeling the least happy when looking at pictures containing only buildings (White et al., 2010). Participants reported feeling

the most joy when looking at pictures of aquatic landscapes with some greenery; aquatic landscapes only; green landscapes with some water; and green landscapes only, in that order. This is consistent with Ulrich's (1981) finding that nature, particularly water, affected mood positively. Videos of water held attention more effectively and increased participants' alpha waves (a brainwave associated with relaxation) compared to the videos of urban settings. Videos of vegetation were the second most effective in retaining attention and increasing alpha waves (Ulrich, 1981).

Korpela et al. (2002) used priming to assess how fast people's emotions changed when observing pictures of nature. Priming is a strategy in which a person will recognize an emotion faster if that emotion is predominant in the person at the moment of looking at the stimulus. Participants observed 6 pictures that included a garden, exotic plants and large trees. They also observed 6 pictures of concrete parking lots. Participants observed one picture at a time and simultaneously heard a vocal stimulus. Some of these vocal expressions were joyful while others were angry expressions of the same word. Participants recognized vocal expressions of joy faster when looking at pictures of nature than when looking at pictures of parking lots. Authors suggest that joy was felt within 200 milliseconds of seeing a *picture* of dense vegetation, water, and little (or no) man-made infrastructure (Korpela et al., 2002). On the other hand, participants recognized vocal expressions of anger faster when looking at pictures of parking lots than when looking at pictures of nature (Korpela et al., 2002).

Similar results were found when participants saw faces instead of listening to vocal expressions. Participants who first saw a picture of nature and then saw a joyful facial gesture recognized the emotion of joy faster than when they first saw a picture of the city. They also took longer to recognize the emotion of disgust after being exposed to pictures of nature (Hietanen, Klemettilä, Kettunen & Korpela, 2007).

One of the explanations as to why humans feel more joyful and invigorated when exposed to nature is that humans have lived in natural environments for 5 million years, therefore their bodies are accustomed and suited to natural settings (Park et al., 2010). Miyazaki (n.d.) further explains that "human bodies are made to adapt to nature" for humans have spent 99.9% of their history in natural environments. He also warns: "artificialization is taking place so rapidly that we now find ourselves in stressful situations and are forced to deal with the resultant pressures. If, under such circumstances, we receive a stimulus rooted in nature itself through such as natural therapy, we become aware of what we humans really are, relax, and perceive this feeling to be very comfortable. This is accomplished without logical thought." (p. 2).

Experiencing frequent positive emotions predicts resilience (i.e., the ability to bounce back from adversity) because the individual is more likely to reframe a difficult life experience from a positive perspective (i.e., optimistic explanatory style) (Cohn, Fredrickson, Brown, Mikels & Conway, 2009; Riolli et al., 2002; Segovia et al., 2012). This optimistic explanatory style includes not attributing a difficult experience to a flawed self (Cohn et al., 2009). An optimistic person may be more likely to communicate negative emotions by reframing a painful experience differently. She may not believe that the negative emotion is an evidence that she is flawed, and therefore may not fear scaring people away by communicating the emotion.

Nature and Communicating Negative Emotions

In summary, exposure to nature seems to decrease the intensity of negative emotions (Park et al., 2010; Ulrich, 1991) which may be caused by the fact that rumination decreases while in nature (Bratman et al., 2015). Exposure to nature also seems to increase the intensity of positive emotions (Hietanen et al., 2007; Korpela, Klemettilä, & Hietanen, 2002; Park et al., 2010; Ulrich et al., 1991; White et al., 2010). In other words, nature is changing people's emotional experience. People may be more likely to express thoughts, feelings and circumstances related to a painful event because the original emotion is no longer experienced. The event still exists in that person's mind, but the emotional experience has changed, and potentially the interpretation of the experience. Positive emotions predict to some extent an optimistic explanatory style of a painful event, which includes avoiding the thought that the self is flawed (Cohn et al., 2009; Riolli et al., 2002; Segovia et al., 2012). After exposure to nature, we may expect less emotional suppression given that the intensity of a particular negative emotion has decreased, and more expression given that the intensity of positive emotions has increased, and perhaps the interpretation of the situation. Based on the literature review, three hypotheses were developed:

H1: People who were exposed to nature will report lower levels of negative emotions than people exposed to a city setting.

H2: People who were exposed to nature will report higher positive emotions than the people exposed to a city setting.

H3: People who were exposed to nature will share more information regarding a negative emotional event than the people exposed to a city setting. Specifically...

(a) People who were exposed to nature will write more words than the people exposed to the city.

(b) People who were exposed to nature will write more negative emotion words than the people exposed to the city.

(c) The people who were exposed to nature will write more consequences associated with the event than the people exposed to the city.

Method

An experiment was conducted to test the proposed hypotheses. Exposure to nature was operationalized as being exposed to nature scenes through a television monitor while sitting in a room. While it is not an ideal operationalization of exposure to nature, it was necessary to conduct a laboratory experiment to establish clean causality. There are several other studies that used a similar operationalization. These studies showed that watching videos of nature seems to affect mental and physical states in a somewhat similar way as being out in nature (Miyakazi, n.d.; Ulrich, 1981; Ulrich et al., 1991). Ulrich et al. (1991) showed that some of the participants' physiological measures (e.g., heart pulse) while watching a 10 minute video of nature evidenced "feeling careful or playful" and "elated or pleased". Park et al. (2010) reported that watching a live forest for 15 minutes improved mood, just as Ulrich did. Thus, the effects of a 10 minute video of nature are perhaps not as intense but produced similar responses as the experience of being out in nature for 15 minutes.

Procedure

Participants were recruited through the Department of Communicology Research sign-up system (SONA), and received a class credit in exchange for their participation. When participants signed up, they were told that the study was about self-compassion; the true nature of the study was not revealed until after the experiment. On arrival, the participant was seated in a small room inside the Communicology department and was asked to read a consent form. After the participant gave her consent to participate, the experimenter randomly assigned her to either the nature or city condition by tossing a coin. Once she was assigned to a condition, the experimenter took the participant to a new room with dim lights. The participant sat in a

comfortable couch in front of a 19'' color monitor with a supplementary speaker system. The window blinds were closed, and there were no paintings or photographs on the walls. The experimenter provided a general description of the procedure and familiarized subjects with the equipment (i.e., room, television and laptop). Participants were told they would watch a video, but the specific content of the video was not revealed. The experimenter told the participant that she would first listen to a song and this time should be used to close her eyes and relax. This moment was used as a baseline. Participants were instructed to open their eyes when the music stopped (2 minute baseline) and look at the screen. All participants then read the following instructions on the screen monitor:

We will now be showing you a short film clip. It is important to us that you watch the film clip carefully. Please do not let your eyes wander from the scene.

Distraction, or not paying attention to a stimulus, is one way to regulate emotion (Gross, 1998; Butler et al., 2003). Participants were asked to pay attention to the monitor so they could fully experience the emotions elicited by the video. In the nature condition, participants watched a video featuring dense vegetation, trees, and water. In the city condition, participants watched a video featuring traffic, and the interior of shopping malls and train stations.

Participants were instructed to answer an online survey immediately after watching the video. A laptop was placed in the room so the subject could easily access the survey. The survey was administered via the platform Qualtrics. Once the participant finished the survey, the experimenter debriefed her and thanked her for her time.

Participants

The subjects consisted of 92 female undergraduate students at the University of Hawai'i. Only women were recruited for this study because research shows that men tend to suppress their emotions to a greater extent (see Butler et al., 2003; Campbell et al., 2007). Thus, a decision was made to only include women to control for potential gender effect. The mean age of participants was 19.8 (SD 3.9). Of the participants, 63% described themselves as Asian, 21% as Caucasian, 7% as Native Hawaiians, 2% as African American and 6% as other.

Stimulus

Two different stimulus videos were created, one for exposure to nature condition and another for exposure to city condition. Each video lasted close to 7 minutes. This time was determined as appropriate to increase the chances of affecting participants' moods because stress markers fluctuate more intensely within 4-7 minutes of watching a stimulus video (Ulrich et al., 1991). The content of both videos aimed to replicate the content of the videos used by Ulrich et al. (1991). The nature video showed selected clips from BBC's documentary "Planet Earth". The sound, however, was slightly modified from the original video. The voice and the music from the original documentary were deleted. Sounds of nature (e.g., waterfalls, tropical birds, forest birds, wind) were downloaded from the internet and integrated into the movie. The final result was a video in which the sound matched the image seen on the monitor. The city video showed roads with traffic, and scenes from shopping malls and train stations. The clips used in the city video were downloaded from YouTube. Table 1 lists the major visual properties of both videos.

Table 1. Description of stimulus videos.

Video	Environment	Visual content	Sounds
Nature video	Jungle	Setting dominated by trees and plants. Some flowers. Some sky. Little openness among trees. No animals.	Loud bird sounds and low sounds of monkeys
	Aquatic landscape	Rain falling on a pond. Fast moving streams. Small streams. Big, heavy waterfalls. Visible ripples and waves. Few people. No animals.	Loud rain and moving water.
	Aquatic landscape and greenery	Waterfalls surrounded by trees. River in between the mountains. Small and big streams surrounded by grass. No animals.	Water falling. Light bird sounds.
	Forest	Mostly trees, some leafs, some flowers, rocks, and mountains. Few people. No animals.	Breeze, light bird sounds.
City video	Shopping mall and train stations	Indoor shopping mall and train station. Few people (3-4) going mostly one-way (their back towards the camera). Several store facades. Artificial light. Elevators and electrical stairs. No animals and no plants.	Voices and background noise.
	Heavy traffic	Many cars (25/minute) moving or stuck in traffic. Few pedestrians. Two-way and one-way roads.	Klaxon sounds. Sounds of car and motorcycle engines.

Research shows that images that contain people have significantly higher preference than images containing scenes only (White et al., 2010). To control for this, both videos contained some scenes with people. However, their faces were not predominant.

Measures

There are three main outcome variables: negative emotion, positive emotion and communicating negative emotions.

Emotions. Both negative and positive emotions were measured using the Inventory of Personal Reactions (ZIPERS) (Zuckerman, 1977). ZIPERS is a brief questionnaire that assesses feelings in 5 domains: fear, positive affect, anger, attentiveness, and sadness. The 5 domains just mentioned are the original labels used by Zuckerman (1977). I acknowledge this scale is measuring two types of emotions — discrete emotions and mood — while clumping them together into the same category: emotions. Yet, this scale was chosen because other authors have successfully used it to assess emotions and mood after exposing participants to videos of nature or city. Subjects read 12 items and assess, on a scale from 1 to 5, how they feel "now". Examples of the items for negative emotions include "I feel sad" and "I feel like acting aggressively and/or avoidantly" (see Appendix for the full scale). For fear, Cronbach's alpha was $\alpha = .78$. For positive emotion, Cronbach's alpha was $\alpha = .78$. For anger, the pearson correlation was $r = .82$[1]. For attentiveness, the pearson correlation was $r = .39$. Both correlations were significant at $p < .01$.

Communicating negative emotions. Communicating emotions was measured through writings. Participants were asked to think of a negative event that they experienced in high school or college that made them feel badly about themselves and explore their emotions in their

[1] Pearson correlation was used for factors that were measured with 2 items.

writings. The instructions were modeled after those used by Pennebaker et al. (1990) on the effects of emotional self-disclosure, but using the scenario used by Leary, Tate, Adams, Batts and Hancock (2007) to examine how self-compassion moderates people's reactions to remembered life-events. The instructions were:

Please think about a negative event that you experienced in high school or college that made you feel badly about yourself—something that involved failure, humiliation, or rejection. We want you to let go and write about your very deepest thoughts and feelings about this negative event. Don't worry about grammar, spelling or editing. The important thing is that you really let go and dig down to your deepest emotions and thoughts and explore them in your writing. You'll have up to 10 minutes to complete this activity, and you can stop at any time. Only the research team will read your writing.

Participants were asked to refrain from editing so that doing so wouldn't distract them from their emotions. Participants were given up to 10 minutes to write. After 10 minutes, the page automatically skipped to the next question. The last sentence of the instruction was added to ensure that participants considered this a communicative act rather than privately disclosing an emotion.

Data Analysis

All 12 items on the ZIPERS scale were analyzed individually. The items were then grouped together into factors. For example, the two items that measure anger were analyzed individually, and then added together into a new variable measuring total anger. This procedure was used for all emotions except sadness, given that sadness was only measured with one item. When Ulrich et al. (1991) used the ZIPERS scale, this is the exact procedure they followed.

The essays were analyzed through two different methods: the software Linguistic Inquiry & Word Count (LIWC) (Pennebaker, Boyd, Jordan, and Blackburn, 2015) and content analysis. Using LIWC, each essay was analyzed to document raw number of words; percentage of self-references (i.e., I); percentage of negative emotion words (e.g., unfortunate, embarrass, annoys); percentage of words expressing anger (e.g., abuse, ugly, envious, mad, petty, mocked); percentage of words expressing sadness (e.g., alone, abandon, hopeless, lost); and percentage of words expressing anxiety (e.g., afraid, horrible, nervous, insecure).

A content analysis was conducted to document additional dimensions of communication reflected in essays. Two coders analyzed the essays using the same instructions. Each essay was read carefully several times and coded for several categories. The first category was the number of mentions of a negative emotion. For example, in the sentence "I was so embarrassed and humiliated", "embarrassed" would be considered one mention of a negative emotion, and "humiliated" a second mention of a negative emotion. This variable also considered sentences that expressed an emotion, for example, "this made me feel crushed". Coders counted the mentions of negative emotions in case LIWC missed mentions of emotions that were written in a colloquial way. Essays were also coded by how delicate or private was the information being disclosed. This variable considered the event itself but also the content, that is, how private or personal were the details that the participant shared. This variable was measured with a scale from 1 to 4, 4 being information one would only share with people that are extremely close or a therapist. The next variable was pain. A participant may have expressed a negative event that could appear seemingly not very painful to an outsider (e.g., losing an item), yet the event seemed to be very painful to that individual for very particular reasons. Thus, essays were coded

by how painful was the experience according to the participant; this variable was also measured on a scale from 1 to 4, 4 being an event that seemed horrifying to experience. Essays were also coded by number of mentions reflecting optimism (i.e., holding a positive expectation for the future) and number of consequences shared. A consequence was defined as a fact or a negative thought related to the self that happened after the event and because of the event (e.g., "I put myself down and started to overthink"; "I kept thinking about how stupid I really am"). The agreement between the two coders was low ($\kappa = .38$, $p < .001$).

Results

Two participants consistently gave very extreme responses and were removed from the analysis. Therefore, the results reported here are based on a sample size of 90.

Positive Emotions

Immediately after watching the video, those who were exposed to nature reported feeling significantly higher levels of positive emotions (i.e., feeling carefree, affectionate, pleased and friendly) than those who were exposed to the city $t(88) = -5.61$, $p < 0.001$, $r^2 = .26$. The mean score of the women exposed to nature was 12.29 ($SD = 2.59$), while the mean score of the women exposed to the city was 8.91 ($SD = 3.10$) Thus, hypothesis 1 was supported.

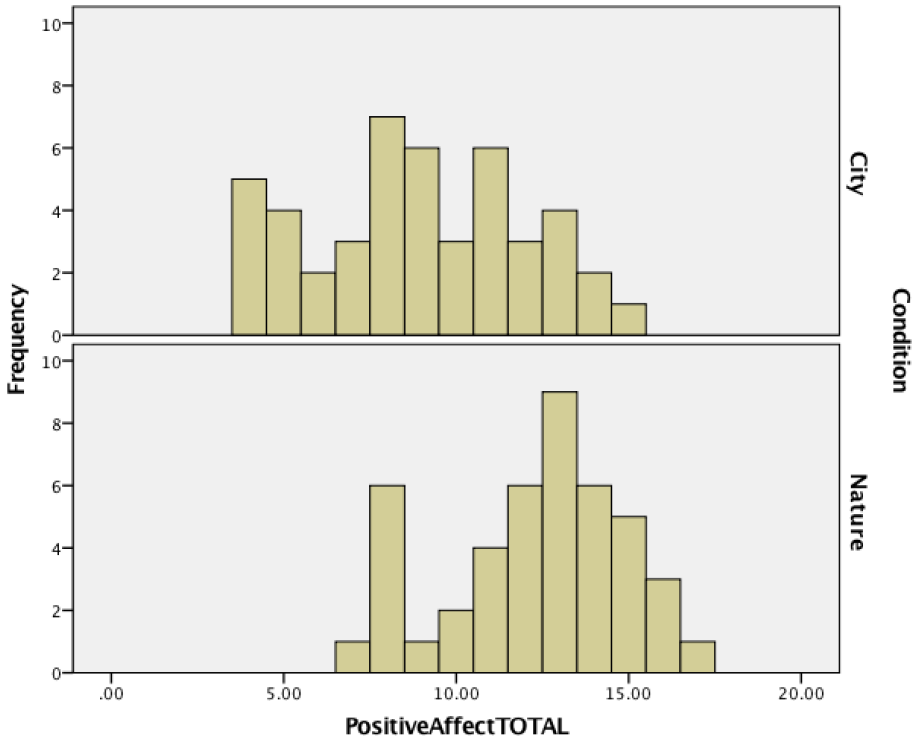

Figure 1. Frequency distributions of positive emotion scores by condition

Interestingly, the women exposed to nature also reported feeling significantly more attentive compared to the women exposed to the city $t(88) = -2.12$, $p < .05$, $r^2 = .05$.

Negative Emotions

As shown in Table 2, subjects exposed to nature reported feeling significantly less angry ($t[88] = 3.28$, $p < .001$, $r^2 = .11$) and less fearful ($t[88] = 2.46$, $p < .05$, $r^2 = .06$) than the subjects exposed to the city. Though not statistically significant ($p = .41$), those exposed to nature also reported feeling less sadness. Thus, hypothesis 2 was supported.

Table 2. Mean scores and standard deviations of negative emotions.

ZIPERS factor	Condition	
	Nature	City
Fear	5.18 (2.20)*	6.50 (2.83)
Anger	2.48 (1.28)**	3.46 (1.53)
Sadness	1.61 (.84)	1.76 (1.01)

* Mean difference is significant at $p < .05$

** Mean difference is significant at $p < .001$.

Communicating Negative Emotions

Content analysis. Around 35% of participants didn't disclose the timeframe when the painful event occured, but for those who did, 72% of them reported an event that happened in highschool, 15% in college, 6% in middle school and one participant reported an event from elementary school. The events revolved around ego related concerns (e.g., achievement, self-

regard) social concerns (e.g., family, friends, romantic partner), physiological concerns (e.g., mental and physical health) and practical concerns (e.g., ownership).

As shown in Table 3, the t-tests showed no significant mean difference in number of mentions of negative emotions, how delicate was the information being shared, nor in the number of sentences that reflected optimism. There was a significant mean difference however in the number of consequences disclosed $t(88) = –2.76$, $p < .05$, and the degree of pain the participant felt during the experience $t(88) = –2.43$, $p < .05$.

Table 3. Mean scores, standard deviations, t-scores, p-values, and effect sizes for the variables of interest in the content analysis.

Variable	Condition		*t*	*p*	r^2
	Nature	City			
Number of mentions of negative emotions	3.41 (2.17)	2.83 (1.89)	–1.36	.18	.02
How delicate was the information	2.76 (1.13)	2.31 (1.11)	–1.89	.06	.04
How painful was the situation	2.84 (1.01)	2.32 (.99)	–2.43	.02	.06
Number of sentences reflecting optimism	.27 (.55)	.58 (1.57)	1.51	.25	.02
Number of consequences	1.87 (1.96)	.95 (.95)	–2.76	.007	.08

Note. Sample size per condition: Nature = 44 and City = 46. Degrees of freedom for the t-test = 88.

Word count data. Histograms and t-tests were conducted for each variable of interest produced by LIWC (i.e., total number of raw words, self-references, negative emotion words, anxiety, sadness and anger words). Though it was expected that those in the nature condition would write more negative emotions than those in the city condition, there was no significant difference (see Table 4).

Table 4. Mean scores, standard deviations, t-scores and p-values for the LIWC variables measuring the expression of negative emotion.

Variable	Condition		*t*	*p*	r^2
	Nature	City			
Total number of words	210.93 (81.90)	202.87 (79.36)	–.47	.64	.00
Percentage of self references	12.78 (2.78)	12.73 (3.10)	–.09	.93	.00
Percentage of negative emotion words	3.59 (1.56)	3.32 (1.51)	–.84	.40	.01
Percentage of anxiety words	.64 (.66)	.63 (.69)	–.13	.90	.00
Percentage of anger words	.86 (.78)	.67 (.82)	–1.15	.25	.01
Percentage of sadness words	1.43 (.92)	1.31 (.92)	–.62	.53	.00

Note. Sample size per condition: Nature = 44; City = 46. Degrees of freedom for the t-test = 88.

During the exploratory analysis of the LIWC variables, it was noted that 21 women exposed to the city wrote zero words of anger. To further explore this behavior, the variable of

anger was transformed from a continuous variable to a categorial variable. Writing zero words of anger was categorized as “suppression” while writing one or more words of anger was categorized as “expression”. Among the women exposed to the city, 45% of them suppressed anger, while 18% of the women exposed to nature suppressed anger (See Figure 2). The *words of anger* variable considers a wide variety of negative words such as humiliating, mad, fight, threat, rude, angry, annoyed, insult, and hate.

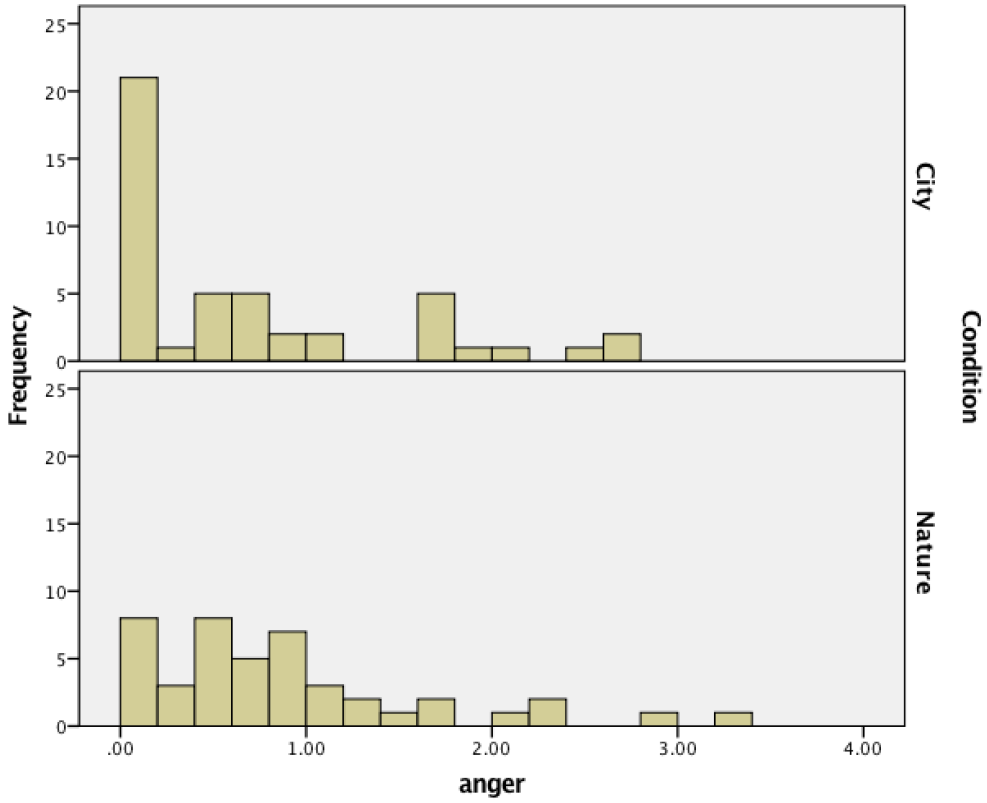

Figure 2. Frequency distribution of percentage of anger words.

To further examine the effects of the experimental conditions on the likelihood of suppressing words of anger, a chi-square test was conducted. There was a significant difference between the video women were exposed to and whether or not they expressed words of anger

$\chi^2(1) = 7.77$, $p = .005$. Although writing about a negative experience will evoke the negative emotion again (Rimé, 2007), it is possible that the negative experience originally evoked other type of negative emotion rather than anger. Thus, participants may not have written words of anger because they were not feeling angry. To account for this, a binomial logistic regression was conducted. The logistic regression model calculated the effects of the video type on the likelihood that participants suppressed word of anger, after controlling for initial feelings of anger. The predictor variables were the video type (i.e., nature and city) and the anger scores participants reported on the ZIPERS scale. As shown in Table 4, the logistic regression model was statistically significant, $\chi^2(2) = 7.99$, $p = .01$, explained 12% (Nagelkerke r^2) of the variance found in the expression of anger, and correctly classified 68% of the cases. Assuming all women felt the same level of anger, women who watched the city video were 3.82 times more likely to suppress anger (i.e., express zero words of anger) than women who watched the nature video, even after initial feelings of anger were controlled for.

Lastly, a sign test was conducted using all the variables of interest that were explored via content analysis and LIWC (see Table 6). Sign tests looks for consistency of relationships. The null hypothesis will be rejected when the number of positive and negative signs differ significantly from equality (Dixon & Mood, 1946). If the content of the videos exerted no real difference in how people communicated negative emotions, the chances of observing that 10 out of 11 variables are in the same direction is 1%.

Table 5. Logistic regression analysis predicting the suppression of anger.

	Outcome variable: Suppressing anger					
	Unadjusted			Adjusted		
Predictor variable	β	OR	*p*	β	OR	*p*
Exposure to city	1.33	3.78	.007	1.34	3.82	.01

It is concluded that we can be 99% confident that the city and the nature videos have significantly different effects in how people communicate negative emotions (Dixon & Mood, 1946).

In conclusion, hypothesis 3a and 3b were not supported. Those exposed to nature didn't write significantly more words nor greater number of negative emotions than those exposed to the city. It is important to mention, however, that this was a small study with only 44 and 46 women per condition. Had I had larger number of subjects, and more reliable measures, I would have likely found more significant relationships. Despite the small number of participants, those exposed to nature showed a significant tendency to be, overall, more expressive than those exposed to the city (i.e., wrote more words, more self-references, more words that express negative emotions, anxiety, anger, and sadness). Hypothesis 3c was supported given that those exposed to nature communicated significantly more details that indicated pain, and significantly more consequences of the event.

Table 6. Sign test of key measures

n	Item	Condition		Sign of (x-y)
		Nature (x)	City (y)	
1	Number of mentions of negative emotions	3.41	2.83	+
2	How delicate was the information	2.76	2.31	+
3	How painful was the situation	2.84	2.33	+
4	Number of sentences reflecting optimism	.27	.58	–
5	Number of consequences reported	1.87	.95	+
6	Total number of words	210.93	202.87	+
7	Self-references	12.78	12.72	+
8	Negative emotion words	3.59	3.32	+
9	Anxiety	.64	.63	+
10	Sadness	1.43	1.31	+
11	Anger	.86	.67	+

Note. n = number of variables

Finally, exposure to nature significantly increased the likelihood that an individual expresses at least 1 or more words of anger, as opposed to suppressing words of anger. Therefore, we can conclude that hypothesis 3 was partially supported.

Discussion

This study provides evidence that exposure to nature in a laboratory setting increased emotional expressiveness. This study also supports other findings that videos of nature enhance positive emotion and reduce negative emotion. This mood shift has benefits for mental health, such as optimism and decreasing the chances of depression. The fact that women reported feeling more attentive after being exposed to nature compared to being exposed to the city is consistent with Attention Restoration Theory. Attention Restoration Theory poses that nature's ability to grab our attention modestly (i.e., involuntary attention) without demanding too much cognitive effort allows direct attention mechanisms a chance to replenish, thus restoring our capacity to pay attention (for more on Attention Restoration Theory see Berman, Jonides & Kaplan, 2008). The mood change experienced by those exposed to nature seemed to affect their expressiveness. Although all participants were asked to share a *painful* experience — hence we can assume all experiences were painful — the way the story was told differed between groups. Women exposed to nature seem to share thoughts, feelings and circumstances related to the event that made the reader understand that the experience was quite painful and the protagonist was quite affected by it. The women exposed to nature shared significantly more facts or negative thoughts related to the self that happened after the event and because of the event (i.e., consequences). Sharing how an event affected the self promotes understanding of what the individual suffered and the potential residuals of that suffering. The listener might be more likely to provide a supportive response if the speaker communicates, not just the emotions associated with an event, but also the consequences. The women exposed to the city were significantly more likely to not express anger, assuming they felt anger, compared to the women exposed to nature. Finally, the

latter followed an unusual pattern of expressing more words, more self-references, more negative emotion words, more anxiety, more anger, more sadness, while also disclosed information that was more delicate, indicated more pain, and shared more consequences than the women exposed to the city — a pattern we can be 99% confident is not happening by chance alone, but rather by the content of the videos. If people exposed to nature feel more attentive, are less likely to suppress words that indicate anger, and have a tendency to be more expressive — the results provided by this study — then the two conditions necessary to form and maintain a relationship (i.e., being responsive and communicating strong positive and negative emotions) are more likely to be satisfied.

To my knowledge, this is the first study that provides evidence that exposure to nature through a video can affect communicative behavior. As to why people exposed to the city might be suppressing their anger or being less expressive, two main reasons come to mind. The first is the intensity of the negative emotion. People reported feeling angrier after watching the city video compared to watching the nature video. If communicating a painful event evokes anger, then this anger adds up to the anger the participant already felt from being exposed to the city. The intensity of the anger might be such that the person would rather not express it as a subconscious strategy to manage it (Campbell-Sills, Barlow, Brown & Hofmann, 2006; Kahn & Garrison, 2009). The second reason has to do with associating the city with competitiveness and social comparisons. Perfection, or hiding one's flaws, might be perceived as necessary to succeed in an environment where people compete against each other for a limited number of positions.

People might judge negative emotions as unacceptable — perhaps a flaw — because it may damage their image or their chances of accomplishing something. Thus, they prefer to not express negative emotion.

People might be more expressive when exposed to nature because nature may change the experience of the emotion. Feeling joy, for example, increases the available energy in the body while silencing worrisome thoughts (Goleman, 2006). By changing the experience of the emotion, worrisome thoughts and the perceived flaws that would inhibit emotion sharing, such as "this feeling is unacceptable", "what's wrong with me" or "people won't like me if I share this" may decrease when one is exposed nature. This mood and mental shift results in an openness to share negative emotions with less inhibitions. This communicative behavior may be fostered by the relaxation one feels in nature. In this study, all participants answered a self-compassion scale that was divided in three subscales: behavioral equanimity, equanimity and personalizing (i.e., blaming the self for a negative consequence). Although the results were not shown, those exposed to nature reported feeling significantly more behavioral equanimity than those exposed to the city. The interpretation of behavioral equanimity is that people are less likely to either blame the self or have strong negative thoughts after failing at something they really cared about, and instead they remain serene. It seems like nature then might be helping people gain perspective on their problems.

As of today, more than 50% of people live in urban areas and by 2050 it is estimated that this number will increase to 70% (see Bratman et al., 2015; Williams, 2017). This study provides a base from which we may infer if this population might be more likely to suppress anger compared to those who are constantly exposed to nature. Considering the effects of suppressing

an emotion (Butler et al., 2003), people exposed to a city environment may run the risk of having a more negative view of themselves and their relational partner, and struggle more at establishing strong meaningful relationships compared to the people exposed to natural environments. Finally, the socioaffective needs of those exposed to the city might not be as fully satisfied if they are consistently suppressing a negative emotion, or not communicating emotion to the extent that the dyad achieves understanding. Perhaps this may explain, to some extent, why urbanization is associated with increased levels of mental illness (see Bratman et al., 2015). We can remedy this situation. Simply adding more trees and plants to urban settings, studies show, can increase people's exposure to nature (see Williams, 2017). Having a tree facing the window of one's house, rather than a building, has significant positive effects in health and behavior (Mitchell & Popham, 2008; Kuo, Sullivan, Coley, & Brunson, 1998; Kuo & Sullivan, 2001a). It is crucial that governments invest in increasing the exposure of citizens to nature by, for example, planting more trees, creating new parks, and maintaining old parks. People can also own plants and see benefits; prosocial behavior has been observed among people that have potted plants in their rooms (see Williams, 2017). Furthermore, public campaigns should encourage people to spend time in green spaces (e.g., forests) for the sake of their physical, mental and emotional health. Japan is a great example of a country who has taken nature as a serious public health antidote. To fight high stress and suicide levels, Japan's Forestry Agency has created forty-eight "Forest Therapy" trails for people to walk and "shower in the green". The Japanese Government has also funded about $4 million in forest-bathing research, and physicians have been certified in forest medicine.

One of the positive aspects about this study was finding results in behavioral data from an experiment conducted in a laboratory setting. Social scientists are aware that behavior is complex and at times difficult to explain. Yet, the effects of exposure to an environment via video were strong enough to affect behavior. If a 7 minute video of nature affected the extent to which people communicate negative emotions, what would happen if we increase the length of the exposure, and switch to a real life setting? Chances are that the differences seen in communication patterns would increase. One study already found that a 20 minute walk in the park seemed to increase closeness and improve communication between mothers and daughters compared to a 20 minute walk in the mall (Izenstark & Ebata, 2017). People should be informed that spending time in natural environments improves mental health and can strength important relationships. Social scientists recommend spending 5 hours a month in completely green spaces to improve emotional well-being (see Williams, 2017).

Limitations and Future Directions

This study has some limitations that should be noted. First, only women and college students were studied, and the results cannot be generalizable to everyone. Future research should study men's disclosure of emotions to observe if the effect of nature is also present in men. The second limitation is that several dependent measures suffer from low reliability as evidenced by the low intercoder reliability of the content analysis. Had we have more reliable measures, we would have been more successful at finding significant relationships. Nonetheless, the results of the content analysis should be interpreted with caution. The third limitation is the fact that the main dependent variable, communication of emotion, was measured by writing an essay in a laboratory rather than by actual communication of their emotions to another person in

a face-to-face situation. In real life, communicating an emotion may be affected not just by the environment but by many other factors such as the relationship with the listener, presence of other people, social norms, the location of conversation, and many other situational factors. We don't know yet if the effects of nature on emotion sharing will increase, decrease, or stay the same outside the laboratory. Future study should explore measuring the disclosure of negative emotion in a real interaction situation with another person rather than essay writings.

Fourth, in this study we used video of scenes from nature and cities. In general, scenes from cities tend to have more crowded visual stimuli as well as quite different kinds of sounds compared to scenes from nature. With the current research design, we cannot be sure if the observed differences are indeed because of exposure to nature and not because of the differences in visual and aural stimuli. Future studies are needed to carefully examine and rule out these alternative explanations. Finally, this study was conducted in a laboratory with a video of nature to simulate exposure to nature, but future research should study the disclosure of negative emotions when people are exposed to live green spaces or cities.

Conclusion

Nature seems to promote the fundamental communication process of emotion sharing, while changing people's mood. Since communicating negative emotions has benefits for well-being and social bonding, efforts should be directed into persuading people to increase their time in nature (e.g., 5 hours per month). The time in nature can be spent alone or with others, in stillness or in movement, but preferably disconnected from technology. Scheduling time in nature becomes more relevant as more than half the global population is transitioning to urban areas. The potential cost of not being exposed to nature could perhaps result in a more robotic society where members are unaware or less sensitive to other's emotions.

Appendix

The Inventory of Personal Reactions (ZIPERS) (Zuckerman, 1977)

Now, at this time…

1. My heart is beating faster
2. I'm breathing faster
3. I feel fearful
4. I feel carefree
5. I feel affectionate
6. I feel elated or pleased
7. I feel like acting friendly or affectionately.
8. I feel angry or defiant
9. I feel like acting aggressively and/or avoidantly
10. I feel attentive
11. I feel like getting further into a situation and through with it
12. I feel sad

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